

beetle. Special mention must be made of the flora in these areas where diversity is particularly high: one 20 acre meadow alone supports approximately 120 species of vascular plant. Away from the wetlands but still pretty damp are the woodlands including Atlantic oak woodland. These woods are tremendous mix of young, old and decaying trees providing great opportunities for birds, invertebrates, bryophytes, lichens and fungi. As well as an existing wealth of wildlife the site has potential for re-colonisation by a number of species including *Sciurus vulgaris* red squirrel and *Avicola terrestris* water vole. With *Castor fiber* beavers being seen in the wider countryside these too could be a regular sight in years to come.

Despite the site having been a NNR since 1962 there are still threats. The change in farming since the 1930's has had a big impact on some of the meadows and fens. As an example Aber Bog, a fantastic 24ha area of would have been cut in rotation by local farmers, the bog hay would have been removed and used as winter bedding for livestock. This practice stopped in the 1930's and has seen a change in structure and diversity of the flora within this area. Recent attempts to manage the fen by cutting with specialist machinery has had mixed success with the biggest issue being the removal of cut material. One of the challenges as we go forward with site management will be how to reinstate sustainable management in areas like this.

A key management decision will be whether to reinstate close control of hydrology through ditch management and sluices or to try and follow the ambitions of the water framework directive (2000) with a more natural, non-intervention approach. This is a key discussion during the current production of a new management plan for the site.

Grazing is a key tool for the favourable condition of the fens and this is why the purchase of the site included some of the higher non-designated grazing pasture. This will allow an effective grazing regime to be established. This still needs to be supported by good infrastructure on the ground and this is another challenge for the coming few years.

Over the past ten years a lot of time has been spent on control of invasive non-native species. Across the wider NNR this has included both mammalian and botanical. The main focus on the Endrick floodplain has been with plant species such as *Impatiens glandulifera* Himalayan balsam, *Fallopia japonica* Japanese knotweed, *Heracleum mantegazzianum* giant hogweed and *Lysichiton americanus* American skunk-cabbage. The main impact of these species is to out compete native flora for space but evidence is suggesting that some species may out compete native flora for pollinators (Chittka et al 2001 and Dietzsch 2011). It is clear that this will continue to

be a focus for work on site but will also need to be considered as part of a catchment wide approach.

Current work is focused on production of a five year management plan. During the process, it has become clear that despite a relatively good historic level of wildlife recording this has not been consistent. One of the challenges has been collecting recent records for some of the rarer species and we have already discovered unrecorded species such as *Bagous lutulentus*, (Gurney 2013) a weevil of wetland habitats (this record is only the second record in Scotland for a hundred years).

People are going to be a big part of delivering conservation objectives at RSPB Loch Lomond. This is where field naturalists and other volunteers will be key to the site's success. It is also the ambition of the partnership to bring visitors closer to the wildlife of the area. This will be achieved gradually in a planned way to ensure that the wildlife comes first and RSPB Loch Lomond provides a great home for nature.

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Bringing beavers back

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The comeback of the Eurasian beaver (*Castor fiber*) can be described as a real conservation success story. Reduced to an estimated 1,200 individuals by

the end of the 19th century predominately through over-hunting, this species has recovered across most of its former native range in Europe through active conservation measures from hunting bans and protection, to proactive translocations and reintroductions (Nolet & Rosell 1998, Halley & Rosell 2002). The success of such measures has resulted in a current population estimate of over 1 million individuals (Halley *et al.* 2012). Several reasons are often cited as to why so much effort has been invested into bringing beavers back. As a former native removed through human actions many believe we have a duty to implement its restoration, and there is a real public desire to do so, which of course is greatly aided when dealing with a charismatic mammal! The European Habitats Directive implies a legal responsibility to at least investigate the restoration of this species within member states where it was previously native. However, most importantly there is significant evidence that beavers and their associated activities generate more complex and dynamic wetland environments (see Rosell *et al.* 2005 for review)

The concept of beaver reintroduction is not new to Britain (see Jones *et al.* 2013). After its extinction in the 16th century small numbers of beavers have been imported, bred in captivity and even released at various points from the 18th century onwards, but these never established as free-living populations. Conservation campaigns for a full beaver reintroduction have occurred at various points but serious discussions began in the 1990's resulting in an application for a trial reintroduction by Scottish Natural Heritage in 2002, which was rejected by the Scottish Government in 2004. The next few years saw credible feasibility studies undertaken in England and Wales (Gurnell *et al.* 2008, Jones *et al.* 2011), and the successful application for a trial release by the Royal Zoological Society of Scotland and the Scottish Wildlife Trust in 2007 led to the establishment of the Scottish Beaver Trial in 2009 following a change in government in Scotland. More recently it has become evident that an unlicensed beaver population has become established on the Tayside river catchment (Campbell *et al.* 2012) and significantly the Scottish Government announced in 2012 that their presence will be tolerated until the conclusion of the official trial in Knapdale, Argyll.

The positive habitat creation and biodiversity benefits created by beavers are exemplified by key activities such as tree felling with the associated opening in the tree canopy spurring vegetation growth and plant biodiversity, and also the creation of dead wood providing breeding and feeding sites for a host of invertebrates and their predators. Dam building creates new wetlands, slowing water to encourage invertebrates, providing spawning ponds for fish and amphibians. These activities along with beaver burrowing behaviours all serve to create a

more complex and dynamic environment for numerous plant and animal species.

Such activities may conflict with human land-use, especially in highly modified landscapes. Burrowing and dam building tend to generate the most significant conflicts and irritation. However knowledge of beaver behaviour and ecology can be used to try and reduce the impact of such conflicts. Human-beaver conflicts tend to occur in and around freshwater bodies, the vast majority of which tend to occur within 20 metres of the water's edge. The creation of 20m buffer zones around water courses and bodies can serve to greatly ease such impacts. Long-term changes in land practices such as not farming to river edges or canalising water ways would also greatly benefit many other species.

Along with biodiversity benefits the ecosystem services beavers can provide such as water purification and water management are particularly evident in dry seasons in Canada for example (Hood 2011). Beaver ponds also act to retain silt and trap nutrients, and these ponds in turn can develop into very fertile beaver meadows when eventually the beavers move on and the dam breaks down dropping water levels. Also the potential positive socio-economic benefits that beaver tourism could bring at a local level should not be ignored (Campbell *et al.* 2007).

Over 26 European countries have already reintroduced the beaver, and experience from these countries has shown that this is a species that will need management, especially in heavily modified landscapes. But for such management solutions to work they need to be pragmatic. Beaver reintroduction will require compromise not only by landowners but also by conservationists and this will require education and experience with beavers in a British context. Ultimately, after such a long absence we need to learn to live with and manage this species again.

So what happens next? There is a strong drive for a full beaver reintroduction and it is increasingly evident that there are free-living beavers present in parts of Scotland and in England to a lesser extent, which are generating scientific, media and tourist interest. However, there are also strong arguments being presented by those opposed, many of which are currently being investigated in a Scottish context through the work of the Scottish Beaver Trial and the Tayside Beaver Study Group. 2014-2015 will see the conclusion of the Scottish Beaver Trial along with information from the Tayside beaver population being gathered by SNH and presented to the Scottish Government, who will then make the decision on whether beavers will remain in Scotland or not. In conclusion there has been a complex history of how beavers have

returned to Britain. Ultimately the decision for them remaining will be a socio-political one, as supposed to an ecologically based decision, with the next two to three years being critical for the future of beavers in Britain, so watch this space.

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Impact of the New Zealand flatworm on Scotland's biodiversity

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The detrimental impact of the New Zealand flatworm (*Arthurdendyus triangulatus*) on both Scotland's above and below ground biodiversity, could in certain parts of the country be considerable. Below ground earthworms play a crucial role in the ecology of many soils as they have a beneficial impact on nutrient cycling, drainage and soil structure while above ground they are a major constituent of the diet of many birds and mammals.

In much of Scotland, earthworm populations are likely to be missing or low in Scotland as many of the soils have a low pH (below that tolerated by earthworms) or the soils are intensively cultivated especially in the east of Scotland (Boag *et al.*, 1998). However, in fields where grass is the main crop, then earthworm numbers can be high (Boag *et al.*, 1997). Jones *et al.*, (2001) studied the impact of the New Zealand flatworm on the composition of the earthworm community in two New Zealand flatworm infested sites and compared these with flatworm free sites in western Scotland and found the numbers of both endogeic and anecic earthworm species were significantly reduced. Experimental research in Northern Ireland has confirmed that the numbers of the anecic species *Lumbricus terrestris* were significantly reduced as was the total biomass of earthworms (Murchie & Gordon, 2013). The indirect impact of reduced earthworm numbers on the size and composition of the populations of other creatures which inhabit soil e.g. collembola, nematodes, enchytraeids and fungi and bacteria have never been investigated.

Alford *et al.*, (1985) did a comprehensive inventory of the above ground animals which feed of earthworms and concluded that where the New Zealand flatworm became established it may lead to the extinction of moles (*Talpa europaea*), and possible local extinction of common shrew (*Sorex araneus*), badger (*Meles meles*), hedgehog (*Erinaceus europaeus*) stoat (*Mustela erminea*) but that foxes (*Vulpes vulpes*) would probably be unaffected. What little evidence we have so far suggests these predictions may be true since in fields in the west of Scotland where moles were once plentiful but have become infested with the New Zealand flatworms moles have been eradicated (Boag & Yeates, 2001). Alford *et al.* (1995) also predicted that there would be a detrimental impact on a number of bird species. At present no research is being undertaken to ascertain the direct or indirect impact of the New Zealand flatworm on Scotland's above or below ground biodiversity.

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